

BENEFITTING THROUGH BOREHOLE DESIGN

DR PHIL HAM
28th October 2015

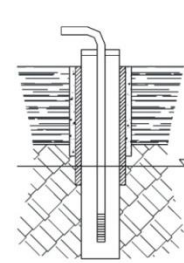


WHAT WE'LL TALK ABOUT

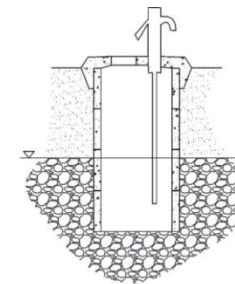
- Types of boreholes
- Design fundamentals
- Construction standards
- Common water quality problems
- Example problems & solutions
- Summary and questions

TYPES OF BOREHOLES

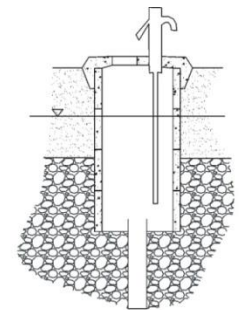
- Lots of different types:
 - Vertical, horizontal, inclined
 - Shallow or deep
 - Hand dug, drilled or a combination
 - Unconsolidated strata, hard rock
 - All with a different design and construction



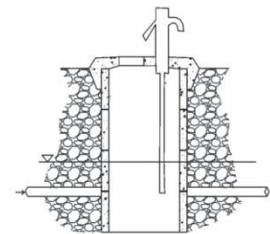
Vertical drilled well,
fractured consolidated aquifer



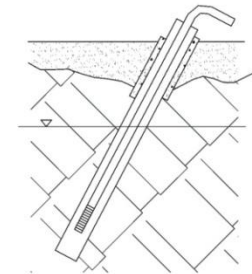
Hand-dug well,
unconsolidated aquifer



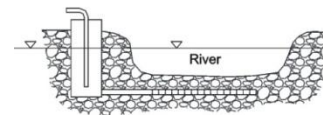
Combined hand-dug well
and drilled well,
unconsolidated aquifer



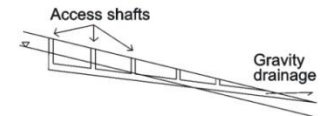
Radial (Rannay) well,
unconsolidated aquifer



Inclined drilled well,
crystalline aquifer



Infiltration gallery in
unconsolidated gravel
aquifer below river bed



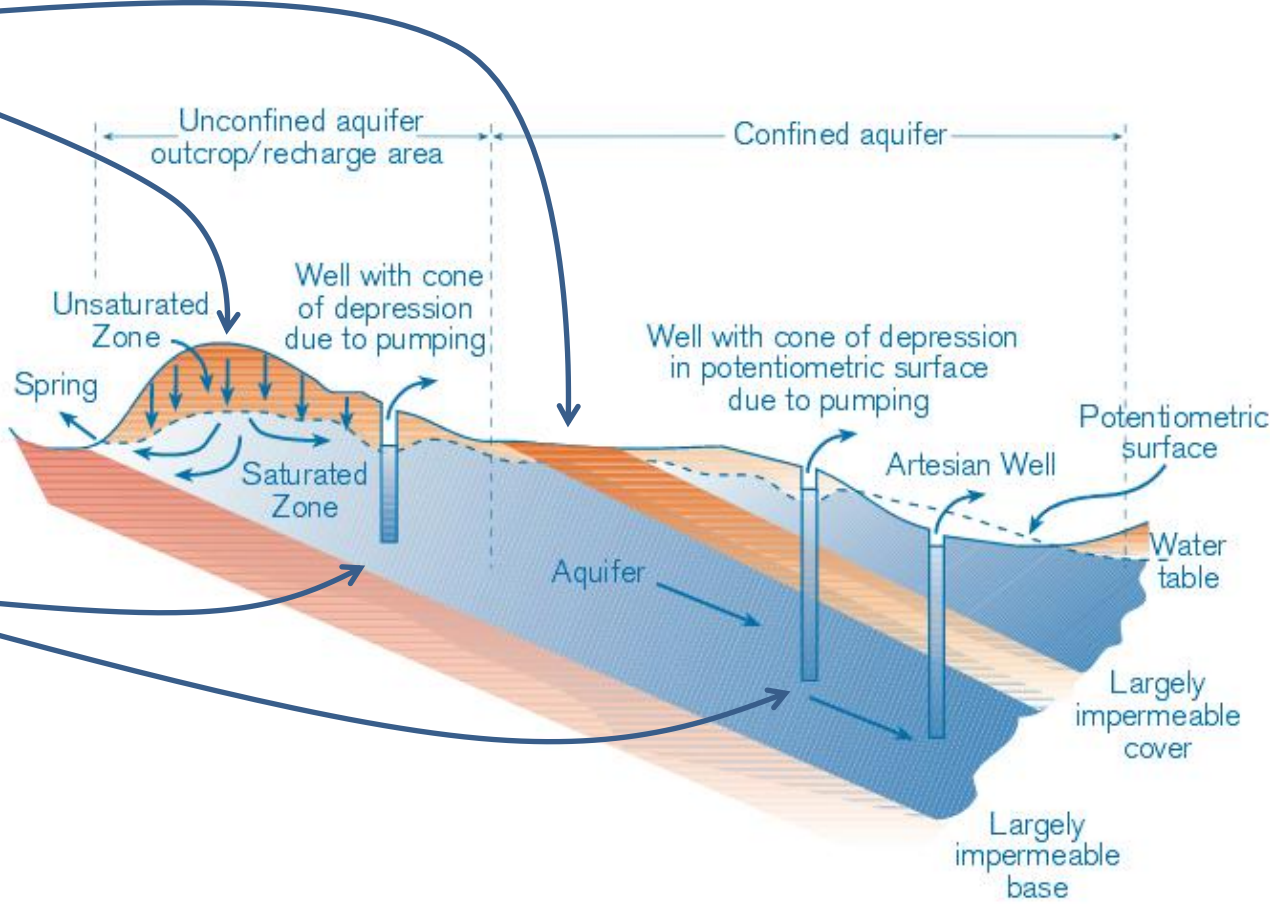
Falaj (qanat) in unconsolidated gravel aquifer

GROUNDWATER SYSTEMS

CATCHPITS



BOREHOLES

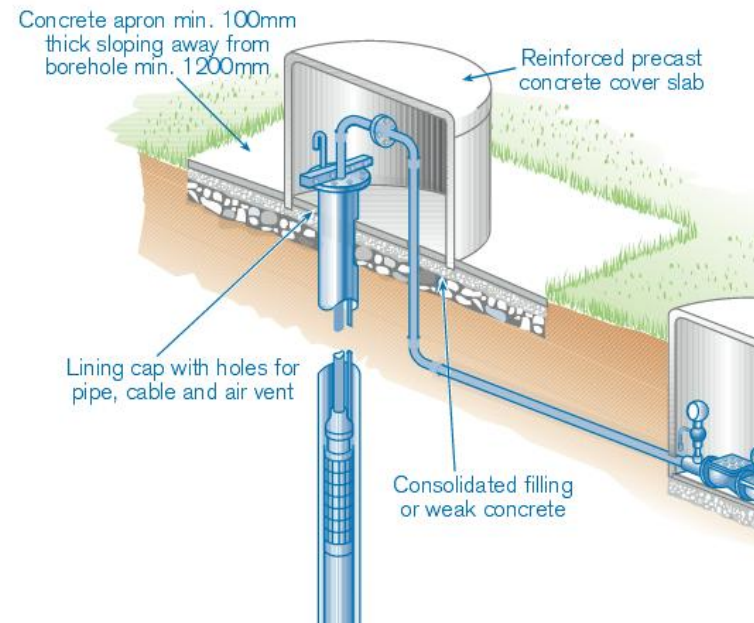
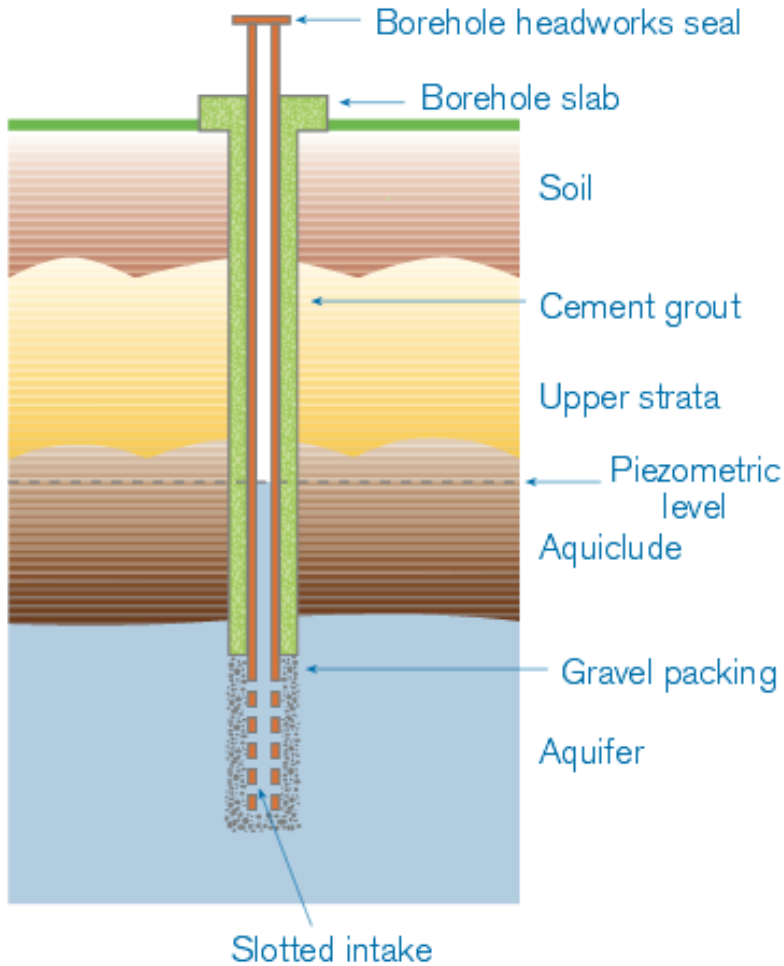


BOREHOLE DESIGN CONSIDERATIONS

- Groundwater systems
- Required yield
 - Will dictate what you target
- Required water quality
 - Should also dictate what you target
 - Water use, e.g. potable or process?
 - Remember quality and chemistry are different!

- Construction methods
 - Depends on yield & water quality requirements
- Construction materials
 - Casings
 - Screens
 - Gravel packs
- Headworks & surface finish
 - Above or below ground
- All to be balanced against cost!

BOREHOLE CONSTRUCTION



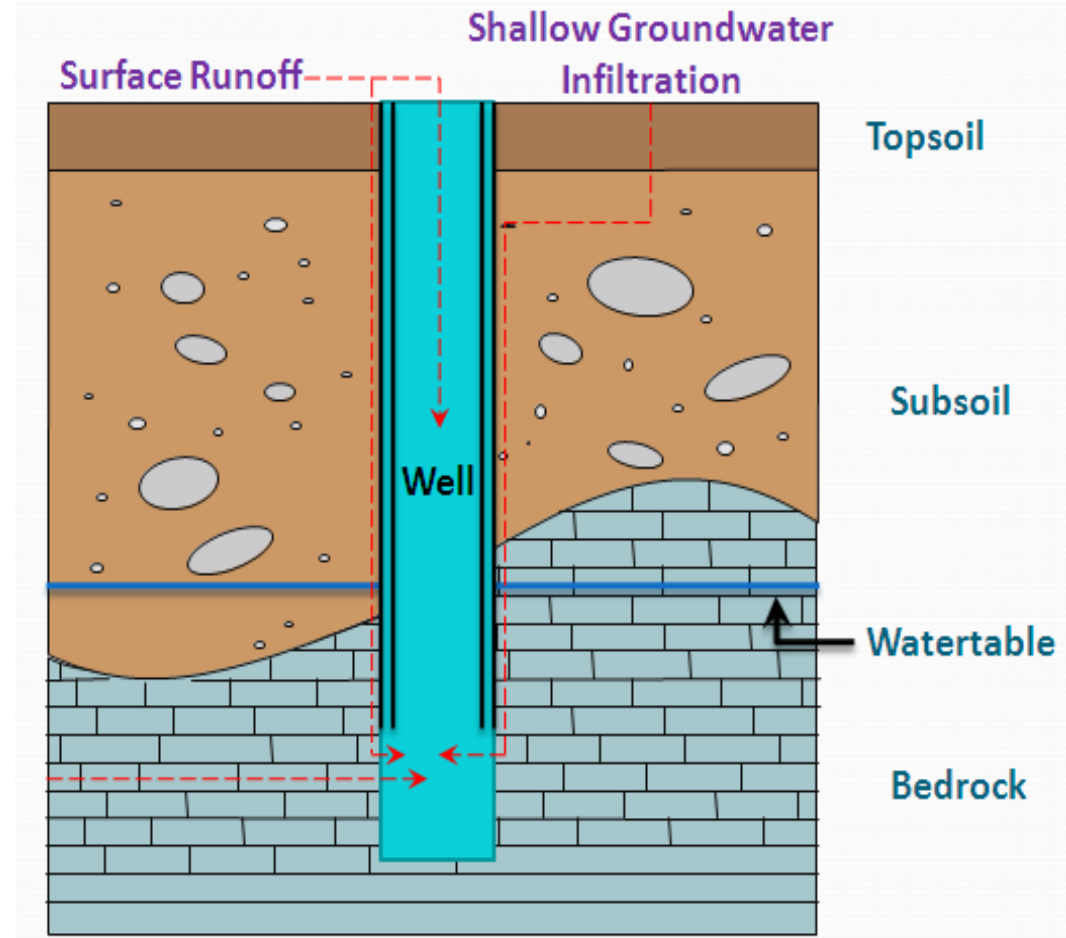
BOREHOLE CONSTRUCTION 'STANDARDS'

- British Standards Institution (BSI):
 - Code of Practice for Test Pumping of Water Wells
 - Water Quality - Sampling. Guidance on the Design and Installation of Groundwater Monitoring Points
 - Specification for Water Well Casing
- Environment Agency:
 - Guidance on the Design and Installation of Groundwater Monitoring Points
- Scottish Environment Protection Agency:
 - Water Supply Borehole Location, Construction and Headworks
- WRC:
 - Well Construction Specification for the Water Industry
- Drinking Water Inspectorate (and others):
 - Private Water Supplies: Technical Manual
- Literature:
 - Water Wells & Boreholes; Water Well Rehabilitation and Reconstructions © Envireau Ltd 2015

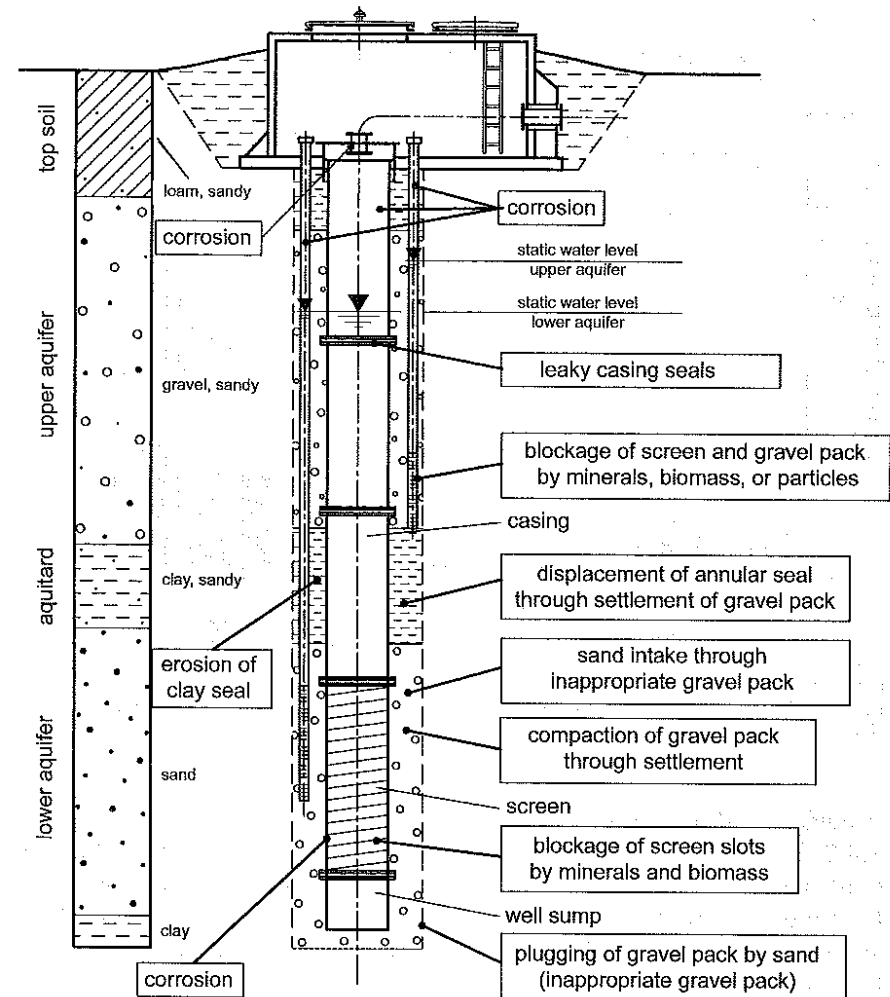
GETTING IT WRONG

- Insufficient (or inconsistent) quantity
- Insufficient (or inconsistent) quality
- Increased risk
- Increased cost
- Borehole failure

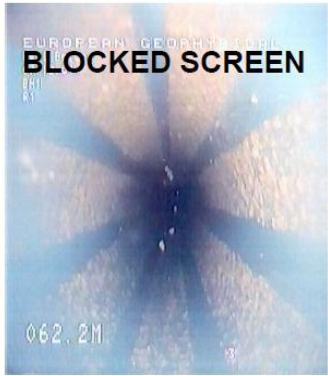
POOR / INADEQUATE CONSTRUCTION



- Clogging
 - Physical
 - Chemical
 - Microbiological
- Collapse
 - Earth
 - Corrosion
 - Erosion
- Sand pumping
- Anything else?



WATER QUALITY PROBLEMS



REDUCTION IN YIELD



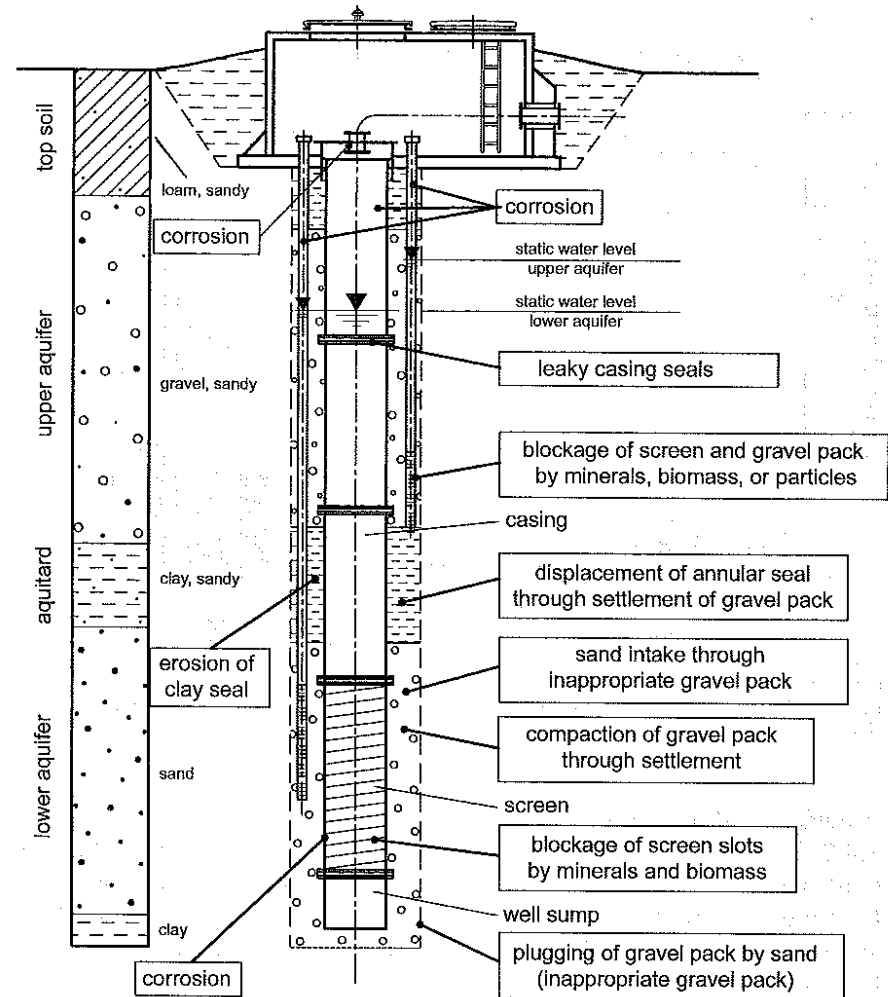
BIOFOULING



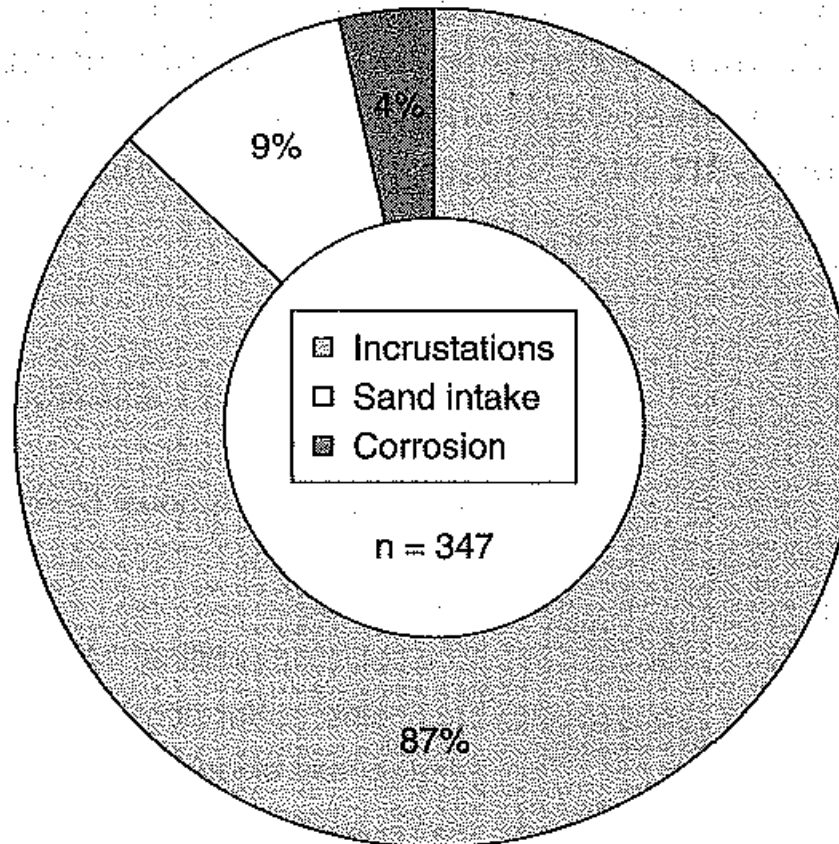
CORROSION



PRECIPITATION



BOREHOLE FAILURE STATISTICS

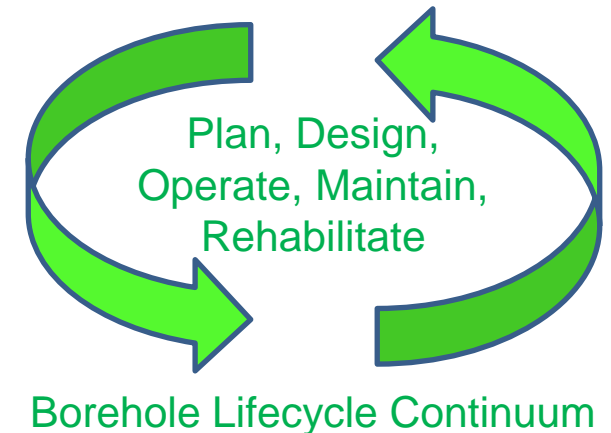


EXAMPLE PROBLEMS & SOLUTIONS



- All boreholes are different
- Design the borehole to meet the objective
- Get the construction right
- Reduce risk
- Save money

- Know what you've got and how it works
 - Borehole construction
 - Groundwater system
- Preventative operation
- Monitor performance
- Maintain
- Rehabilitate
- Replace – not where we want to be!



QUESTIONS?

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WATER

**BORE
HOLE
USERS
CONFERENCE 2015**

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